

José M. D. C. Marques

CNRS - Institut de Mécanique des Fluides de Toulouse
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Research Experience

PhD Research

2023 – on going

Department of Reactive Media, Institut de Mécanique des Fluides de Toulouse - CNRS

- Development of reliable and fast numerical solvers for plasma-gas interactions using stabilised finite element methods
- Numerical modelling of electro-aero-dynamics, specifically atmospheric gas discharges, like corona discharges, in the presence of an external flow.
- Modelling of ionic wind applications for propulsion : use of the developed solvers to design, and optimize test the propulsive characteristics of such thrusters.
- Perturbative, asymptotic and stability analysis of plasma-gas interactions.

Master Research

2023

Paris Observatory, Meudon campus

- Numerical study of the non-collisional relaxation of electron distribution functions in the solar wind.
- Monte-carlo simulations of the electron distribution functions around the magnetic field lines of the Sun.

Publications

Two-way perturbative coupling of plasma–fluid interactions

J. M. Dias Coelho Marques, D. Fabre and F. Plouraboué

Journal of Physics D: Applied Physics, 2025. DOI: 10.1088/1361-6463/ae07f9

Numerical Configuration Study of Ionic Wind for Propulsion via a Two-Way Electro-Aero-Dynamic Modelling

J. M. Dias Coelho Marques, D. Fabre and F. Plouraboué

EUCASS Conference Proceedings, 2025

Probing Turbulent Scattering Effects on Suprathermal Electrons in the Solar Wind: Modeling, Observations, and Implications

Arnaud Zaslavsky, Justin C. Kasper, Eduard P. Kontar, Davin E. Larson, Milan Maksimovic, José M. D. C. Marques, Georgios Nicolaou, Christopher J. Owen, Orlando Romeo, and Phyllis L. Whittlesey

The Astrophysical Journal., 2024. DOI: 10.3847/1538-4357/ad2e92

Conference Talks

Perturbative Two-Way Plasma-Fluid Interactions

Gaseous Electronics Conference (APS-GEC), Seoul, 2025

J. M. Dias Coelho Marques, D. Fabre, and F. Plouraboué

Numerical Configuration Study of Ionic Wind for Propulsion via a Two-Way Electro-Aero-Dynamic Modelling

EUCASS, Rome, 2025

J. M. Dias Coelho Marques, D. Fabre, and F. Plouraboué

Conference Poster Presentations

Two-Way Electro-Hydro-Dynamic Coupling Modeling of Ionic Wind with an External Flow

International Conference on Phenomena in Ionized Gases (ICPIG), Aix en Provence, 2025

J. M. Dias Coelho Marques, D. Fabre, and F. Plouraboué

Two-Way Electro-Hydro-Dynamic Coupling Modeling of Ionic Wind with an External Flow

American Physical Society : Division Fluid Dynamics (APS-DFD), Salt Lake City, 2024

J. M. Dias Coelho Marques, D. Fabre, and F. Plouraboué

Projects and collaborations

Horizon EIC Pathfinder project IPROP

- Aims to develop propulsive technologies based on ionic wind generated by atmospheric plasma discharges.
- My contribution focuses on the numerical modelling of plasma–fluid interactions in the presence of external flow, by developing numerical solvers relying on the stabilized finite-element method allowing for the study, design and optimization of ionic wind propulsion devices and to better understand the multiphysics mechanisms governing ionic wind generation and plasma interactions with airflows, as well as allowing practical and accurate thrust, thrust-to-power ratio, and efficiency estimation.

Teaching Experience

Lecturer — Université de Toulouse III - Paul Sabatier 2024

- 32h – 3rd year of Bachelor: Advanced Mathematical Methods for Mechanics

Teaching Assistant — Université de Toulouse III - Paul Sabatier 2023–2025

- 32h – 3rd year of Bachelor in Mechanics: Teaching Assistant, Mathematical Methods for Mechanics
- 31h – 1st year of Bachelor: Introduction to Mathematics
- 28h – 1st year of Bachelor in Mathematics: Calculus I
- 28h – 1st year of Masters in Mechanics: Introduction to Finite Element Method (FreeFem++ training)
- 8h – 2nd year of Bachelor in Mathematics: Numerical Methods (Python training)
- 32h – 3rd year of Bachelor: Advanced Mathematical Methods for Mechanics

Tutor — Sorbonne Université – Sciences, Paris, France 2021–2023

- Delivered practical sessions and tutorials to first-year students in Physics and Mathematics

Education

PhD Fluid Dynamics 2023– ongoing

CNRS/IMFT — Numerical modeling of electro-aero-dynamics for ionic wind propulsion

Masters in Mathematics and Applications 2021–2023

Sorbonne Université - Sciences, Paris, France

Double Bachelors in Physics and Mathematics 2018–2021

Sorbonne Université - Sciences, Paris, France